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Discussions

Interactive comment on "A Singular Value Decomposition framework for retrievals with vertical distribution information from greenhouse gas column absorption spectroscopy measurements" *by* Anand K. Ramanathan et al.

Anonymous Referee #1

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General comments:

This is an important and well executed paper which should be published without delay. The subject of greenhouse gas retrievals from remote measurements is a critical one for advancing scientific knowledge of climate processes using an extensive new generation of instruments, networks, and techniques including OCO-2, GOSAT, TCCON, and IPDA lidar measurements.

The authors clearly develop the mathematics of the SVD technique and present a well-

chosen example of its application to GHG retrievals. While the SVD technique has a long history, the authors' careful analysis of it's mathematical relationship to the 'de facto standard' OE, and its practical comparison to OE, in the context of GHG retrievals, is new and very informative.

As one of the principal developers of the use of OE for GHG retrievals from remote spectral measurements, I do have reservations about the practical use of SVD in place of OE. Namely the main error sources in such retrievals are forward model errors and interference from state vector elements of less interest than the target species. Also, the forward models for the infrared spectral measurements exemplified by OCO-2 etc. are moderately non-linear. Neither of these fundamental issues are addressed, as the authors themselves note in section 7, calling for future work. However the current paper makes it clear that further investigation and development of SVD in this context may lead to important advances.

Specific comments:

P 4 line 22: 'better representing' I don't know what is meant here, please restate.

P 7: forward model definition. I find this section confusing. The measurement vector y is described as the deviation in the absorption from that corresponding to x_u, but that is not a measurable quantity and the statement is contradicted by Eq. (4). Near the bottom of page 8 it is claimed a valid choice for the reference profile is $x_u = 0$, so that y is a 'deviation' from zero.

I believe this is correct in the end, and exploits the assumed linearity of the problem, but it is still not entirely clear to me, and I think the concepts should be better explained.

P 21 line 7: 'to the create'

P 28 line 11: 'bias-free estimate' This is not true in general, as the authors have themselves noted on P 4 line 24. It should be qualified or its applicability defined.

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